Aerial Surveys of the Waterbirds of the Slave River, Slave River Delta, and Adjacent Shoreline of Great Slave Lake, 1983

H. Loney Dickson, D. Lynne Dickson, Sam J. Barry and Alan R. Smith

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EXECUTIVE SUMMARY

In response to a (now unrealised) intention of the Government of Alberta to develop a major hydroelectric project on the Slave River, we conducted aerial surveys of the Slave River region of Alberta and the Northwest Territories to obtain baseline data on its use by waterbirds for spring staging and breeding. The area included the Slave River including adjacent waterbodies, the Slave River Delta and the adjacent south shore of Great Slave Lake. Four spring surveys of waterbirds were conducted between 11 May and 1 June 1983, followed by two waterfowl brood production surveys on 18 and 26 July.

The results of spring surveys showed temporal changes in waterbird distribution which reflected the spring break-up. Waterbird numbers were the highest in the Slave River Delta and southern portion of the study area on the 18-19 May survey, while they were the highest along the previously frozen south shore of Great Slave Lake on the 25-26 May survey. Overall, ducks, geese and swans were most abundant on 25-26 May when over 93000 were observed in the study area.

Our data indicate that the Slave River region contains important spring staging areas for waterbirds en route to Subarctic and Arctic breeding grounds. In addition, the Slave River Delta appears to be of local importance for nesting ducks. Any perturbations in the streamflow as brought about by a possible dam or diversion, or through climate change could greatly effect the value of this area as waterbird habitat. The highest numbers and densities of geese and swans in the study area during spring migration occurred in the bays along the south shore of Great Slave Lake just east of the Slave River Delta. The peak number of geese found there was 52000 (density: 409 geese per km of a 400m wide survey strip), and peak number of swans was 3560 (density 33/km). Ducks were more widely distributed along the Slave River including on the delta and adjacent lakes, but like other waterfowl, the south shore of Great Slave Lake harboured the highest numbers (peak count of 7800 along south shore). The Slave River itself had relatively few waterfowl, the highest densities occurring downstream of Fort Smith (9 birds/km). Shorebird numbers peaked later than waterfowl, the highest counts occurring during the last survey on 1 June. Shorebirds were most abundant on the mudflats in the outer Slave River Delta, in the bays to the east of the delta, and on Hook and other inland lakes.

Where available, comparison of our waterfowl survey results were made with other published surveys. Based on those comparisons, peak migration in 1983 was similar to 1979, but over two weeks earlier than in 1984. A comparison of our data from the south shore of Great Slave Lake with similar data from 1979 showed a much greater use of the area in 1983 (peaks of 63521 birds in 1983 *vs.* 17827 in 1979).

Waterfowl production surveys in the Slave River Delta revealed 28 broods with 122 young on 18 July and 27 broods with 130 young on 26 July. A 1978 survey conducted along identical transects yielded 47 broods and 201 young. These data suggest a decline in waterfowl production in 1983.

SOMMAIRE

À la demande du gouvernement de l'Alberta qui avait l'intention (qui ne s'est pas concrétisée) de réaliser un grand aménagement hydroélectrique sur la rivière des Esclaves, nous avons mené des relevés aériens dans la région de la rivière des Esclaves en Alberta et dans les Territoires du Nord-Ouest dans le but d'obtenir des données de départ sur l'utilisation de cette région par les oiseaux aquatiques comme haltes migratoires au printemps et lieux de reproduction. La région comprend la rivière des Esclaves et ses plans d'eau adjacents, le delta de la rivière et la rive sud du Grand lac des Esclaves. Du 11 mai au 1er juin 1983, nous avons effectué quatre relevés printaniers d'oiseaux aquatiques et, le 18 et le 26 juillet, deux relevés de couvées de sauvagine.

Les résultats des relevés printaniers indiquent des changements temporels dans la distribution des oiseaux, qui correspondent à la débâcle printanière. Lors du relevé du 18 et du 19 mai, nous avons trouvé les plus grands nombres d'oiseaux aquatiques dans le delta de la rivière des Esclaves et dans la partie sud de la zone d'étude, alors que lors du relevé du 25 et du 26 mai, c'était le long de la rive sud libérée des glaces du Grand lac des Esclaves. Dans l'ensemble, c'est au moment du relevé du 25 et du 26 mai que les canards, les oies et les bernaches et les cygnes étaient les plus nombreux : nous en avons compté plus de 93 000 dans la zone d'étude.

Les données révèlent que la région de la rivière des Esclaves renferme de grands secteurs de haltes printanières pour les oiseaux aquatiques se rendant dans les aires de reproduction subarctiques et arctiques. À l'échelle locale, le delta de la rivière des Esclaves semble, par ailleurs, important pour les canards nicheurs. Des modifications à l'écoulement fluvial, qu'entraîneraient la présence d'un barrage ou le détournement du cours d'eau ou que produirait un changement climatique, pourraient nuire considérablement à la richesse de la région en ce qui a trait aux habitats d'oiseaux aquatiques. Lors de la migration printanière, nous avons observé les plus grands nombres et les plus grandes densités d'oies et de bernaches et de cygnes pour la zone d'étude dans les baies de la rive sud du Grand lac des Esclaves, légèrement à l'est du delta de la rivière des Esclaves. Nous y avons dénombré alors un maximum de 52 000 oies et bernaches (densité de 409 individus par km sur une bande d'une largeur de 400 m) et de 3 560 cygnes (densité de 33 par km). Quant aux canards, leur distribution était plus éparse le long de la rivière ainsi que dans le delta et les lacs adjacents; cependant, à l'instar des autres espèces de sauvagine, ils étaient plus nombreux sur la rive sud du Grand lac des Esclaves (nombre maximum de 7 800). Le long de la rivière des Esclaves elle-même, il y avait relativement peu de sauvagine, les plus fortes densités se trouvant en aval de Fort Smith (9 oiseaux par km). Nous avons noté le maximum d'oiseaux de rivage plus tard que celui de la sauvagine, les plus grands nombres ayant été observés lors du dernier relevé, le 1er juin. Les oiseaux de rivage étaient plus nombreux dans les battures de la zone externe du delta de la

rivière des Esclaves, dans les baies situées à l'est du delta ainsi qu'au lac Hook et à d'autres lacs de l'intérieur.

Lorsque les données d'autres relevés de sauvagine étaient disponibles, nous les avons comparées à celles de nos relevés, et constaté que le point culminant de la migration de 1983 était semblable à celui de 1979, mais qu'il avait devancé de plus de deux semaines celui de 1984. En comparant les données de la rive sud du Grand lac des Esclaves à des données semblables de 1979, nous avons remarqué que la région avait été beaucoup plus utilisée en 1983 (maximums de 63 521 oiseaux en 1983 contre 17 827 en 1979).

Au moment du relevé de production de sauvagine du 18 juillet dans le delta de la rivière des Esclaves, nous avons dénombré 28 couvées et 122 jeunes, alors que nous avons compté 27 couvées et 130 jeunes le 26 juillet. En 1978, lors d'un relevé mené le long des mêmes transects, on a compté 47 couvées et 201 jeunes. De telles données indiquent une baisse de production de sauvagine en 1983.

ACKNOWLEDGEMENTS

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1.0 INTRODUCTION

In 1979, the Government of Alberta announced its intention to develop a major hydroelectric project on the Slave River. The location of the proposed dam was in Alberta on the Slave River upstream from Fort Smith, Northwest Territories. In January 1980, the Federal Environmental Assessment Review Process (FEARO) was initiated for the project and on 11 August 1982, the draft Environmental Impact Statement Guidelines were released by FEARO. With the project proposal gaining momentum, we initiated a study of migratory birds in the Slave River region including the Slave River, the Slave River Delta, and the south shore of Great Slave Lake from Jean River east to Talston Bay. The study consisted of aerial surveys conducted in the area between 11 May and 26 July 1983. The objectives of the study were:

1. to assess spring waterbird use of the Slave River region with a focus on waterfowl.
2. to assess waterfowl production in the Slave River Delta.
3. to identify how the proposed project might effect the migratory bird resources of the region.

In the fall of 1983, Environmental Management Associates (EMA) were awarded a contract to conduct surveys nearly identical to those of our study. To avoid duplication of effort, our project was dropped at the end of 1983. In 1986 the Slave River Hydroelectric Project Proposal was shelved due to an unfavourable economic climate. This report presents the findings and conclusions of the 1983 aerial surveys. Where possible, comparisons are made to other surveys conducted in the area. These include surveys conducted in 1978 and 1979 by Thompson *et al.* (1979) and in 1984 by Environmental Management Associates (1984, 1985).

Although the aforementioned hydrologic development has been long been mothballed, it is hoped that the information presented herein will be useful as baseline data should river flows change in the Slave, Peace and Athabasca river basins as a result of any possible dam or diversion. Furthermore, these data may also be useful in assessing the possible impact of climate change on the river system.

2.0 STUDY AREA

The Slave River Study Area (Figure 1) extends from northeastern Alberta north to Great Slave Lake in the Northwest Territories (58° 15' to 61° 30' north latitude and from 111° 00' to 114° 00' west longitude). Included is the full length of the Slave River, the Slave River Delta and about 100km of the south shore of Great Slave Lake.

The study area was divided to facilitate comparison between wetland areas that might be influenced by hydrological changes to the Slave River and those that would not (Table 1, Figure 1). The Slave River Delta (region 1), the south shore of Great Slave Lake (region 2), the Slave River below Fort Smith (region 4), and Ring and Hook lakes (regions 5,6) would be directly effected by a dam. The Slave River above Fort Smith (region 7) would be effected to the extent of flooding by the reservoir created by the dam. Areas east of the Slave River Delta (region 3) and the lakes and other waterbodies adjacent to the upper reaches of the upper Slave River (regions 8,9) would presumably not be affected. These survey results, along with those of the other investigators, can thus be used to evaluate the effects of alterations of river flow on waterbird use in the study area.

Figure 1. Slave River Study Area, showing regional divisions.

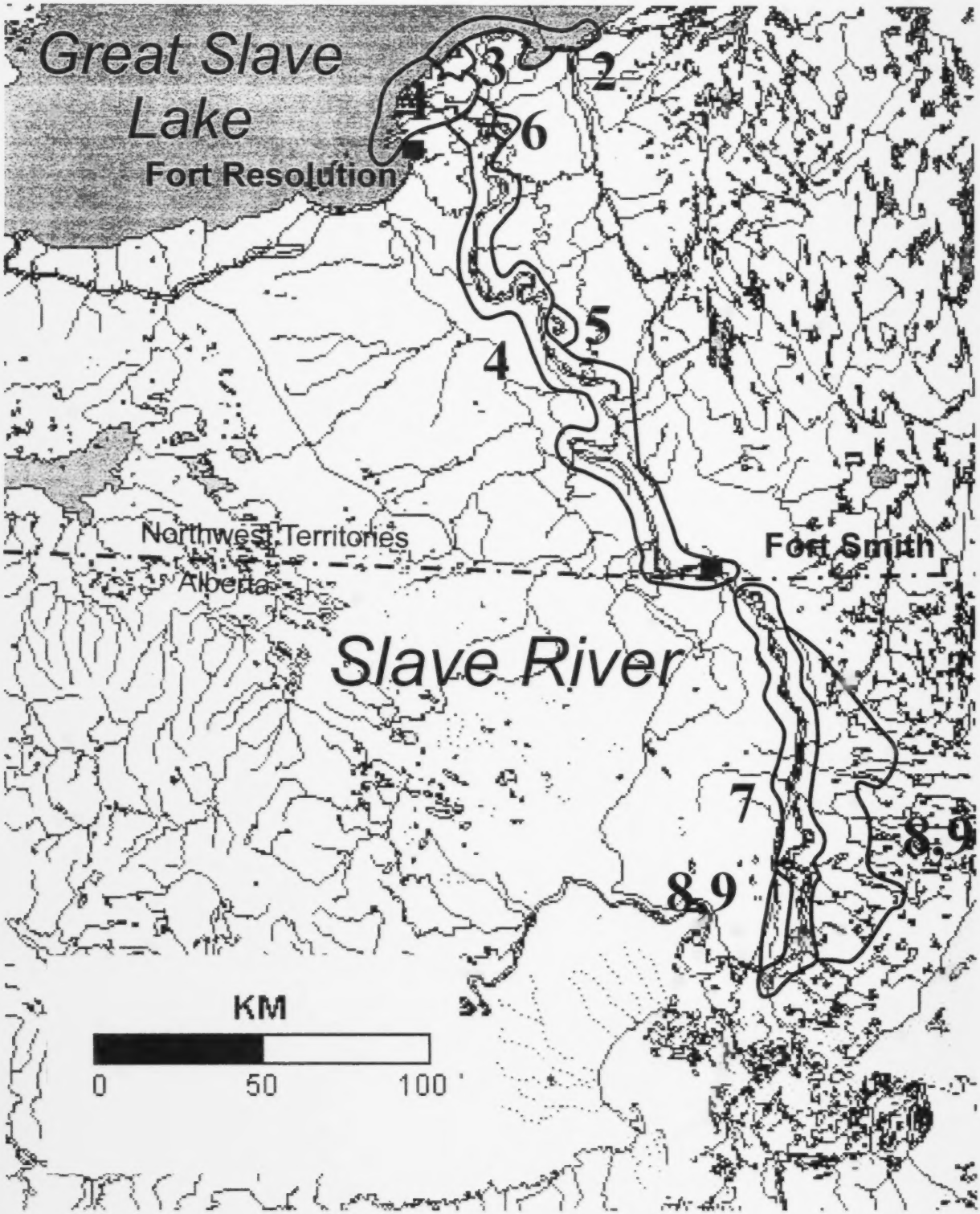


Table 1. Regions of the Slave River Study Area, with transect numbers and kilometres surveyed.

Region	Abbreviation	Transect numbers	Km surveyed
Northwest Territories			
1. Slave River Delta	S. R. Delta	1-12, 15-23, 27-38, 40-61	169.45[a]
2. South Shore of Great Slave L.	S. Shore	62-71	105.18
3. Inland, East of Slave R. Delta	E. of Delta	13, 14, 24-26, 39	41.06
4. Slave River north of Fort Smith	S. R. North	72, 73, 75-79, 81-84	290.94
5. Hook Lake		80	22.93
6. Ring Lake		74	10.36
Alberta			
7. Slave River south of Fort Smith	S. R. South	85-89	140.40
8. Major inland lakes	Major lakes	94, 103, 105, 113, 115	29.66
9. Other inland waterbodies	Other bodies	90-93, 95-102, 104, 106-112, 114, 116-119	217.21[b]
Slave River Study Area	**S. R. S. A.**	**1-119**	**1057.27**

[a] Transects 50-53, 61 (24.38km) not surveyed.
[b] Transect 95 (4.70km) not surveyed.

3.0 METHODS

3.1 Spring Waterbird Surveys

We conducted spring aerial surveys from a STOL kit equipped Cessna 185 at 160kph at 30m above ground level (agl). We flew surveys along transects plotted on 1:50,000 NTS maps and divided into sections for accurate recording of the location of all birds observed. We determined transect section lengths with aid of a Hewlett-Packard planimeter program. The locations of the transects flown during these surveys are indicated in Figures 2, 3, 4 and 5, and lengths of transects are presented in Appendix 1.

We flew five surveys between 11 May and 1 June, 1983 (Table 2). The first survey was a reconnaissance of the study area. The second survey, the first census, was conducted on 12 May and included the Slave River south of Fort Smith and a partial survey of lakes and other waterbodies adjacent that stretch of the river. As the reconnaissance had revealed little or no open water elsewhere, surveys were not conducted on this day in the rest of the study area. The third survey was flown on 18 and 19 May. The Slave River Delta, Hook and Ring Lakes were each surveyed twice. The results of these two surveys were combined by presenting the maximum number of birds seen on either day. Results for Hook and Ring lakes are also presented separately (Tables 15 and 16). The fourth survey was begun on 25 May and completed on 26 May, while the fifth and final survey was conducted on 1 June.

Table 2. Coverage by survey (km flown), Slave River Study Area, spring 1983.

Region	12 May	18-19 May	25-26 May	1 Jun
1.S. R. Delta	0.00 (n.s.)	169.45 (complete)[b]	169.45 (complete)	169.45 (complete)
2.S. Shore	0.00 (frozen)	0.00 (frozen)	105.18 (complete)	105.18 (complete)
3.E. of Delta	0.00 (n.s.)	41.06 (complete)	41.06 (complete)	41.06 (complete)
4.S. R. North	0.00 (n.s.)	290.94 (complete)	290.94 (complete)	113.53 (partial)[a]
5.Hook Lake	0.00 (n.s.)	22.93 (complete)[b]	22.93 (complete)	0.00 (n.s.)
6.Ring Lake	0.00 (n.s.)	10.36 (complete)[b]	10.36 (complete)	10.36 (complete)
7.S. R. South	140.40 (complete)	140.40 (complete)	140.40 (complete)	0.00 (n.s.)
8.Major Lakes	13.46 (partial)	32.43 (partial)	25.20 (partial)	0.00 (n.s.)
9.Other bodies	217.21 (complete)	215.62 (partial)	185.39 (partial)	0.00 (n.s.)
Total	**371.07**	**923.19**	**990.91**	**439.58**

[a] Data not presented: [b] Completely surveyed on both dates.

Two observers, one on each side of the plane, recorded the species, number of individuals, and transect section of each observation. We designated observations made within a 400m wide strip (200m on each side of the aircraft) as "on transect". Birds observed beyond the 200m distance were recorded as "off transect." We used Sony TCM-121 tape recorders to record observations. Data were transcribed to forms following each survey. Density of birds was calculated using "on transect data" only and expressed as the number of birds per linear kilometre of the 400m wide survey strip.

Where possible (i.e. portions of the Slave River Delta, South shore of Great Slave Lake and the Slave River), comparisons have been made between this survey and those conducted in 1979 by Thompson *et al.* (1979) and in 1984 by EMA (1984). To make the data from all three years comparable, we combined our "on and off transect" sightings, and included only the comparable data from our surveys (Tables 8, 10, and 14).

3.2 Waterfowl brood production surveys

To determine waterfowl production on the Slave River Delta, we flew surveys on 18 and 26 July 1983. We conducted both surveys from a Bell 206B helicopter flown 30m agl and at 80kph. We flew surveys over predetermined transect lines which were divided into sections for ease of recording the location of observations (Figure 6). For each brood sighted, we identified the species, number of young, and age class (Gollop and Marshall 1954). We combined the results of the two surveys to determine the maximum production levels. Transect widths and general survey methods are the same as described for the spring surveys (section 3.1). Observations of other birds made during these surveys are presented in Appendix 3.

Figure 2. Transects flown, Slave River Delta, spring 1983.

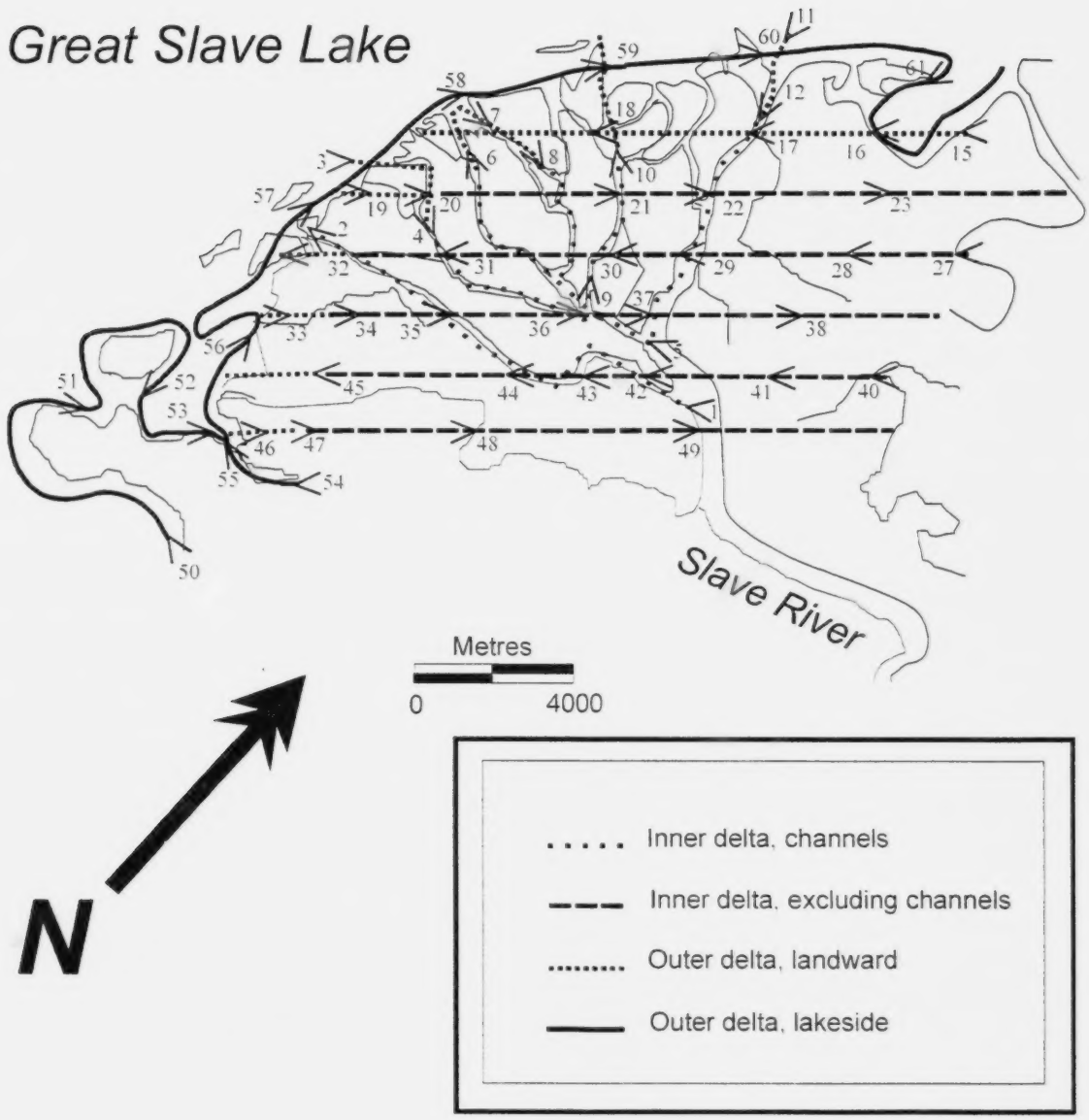


Figure 3. Transects flown, south shore of Great Slave Lake and inland east of Slave River Delta, spring 1983.

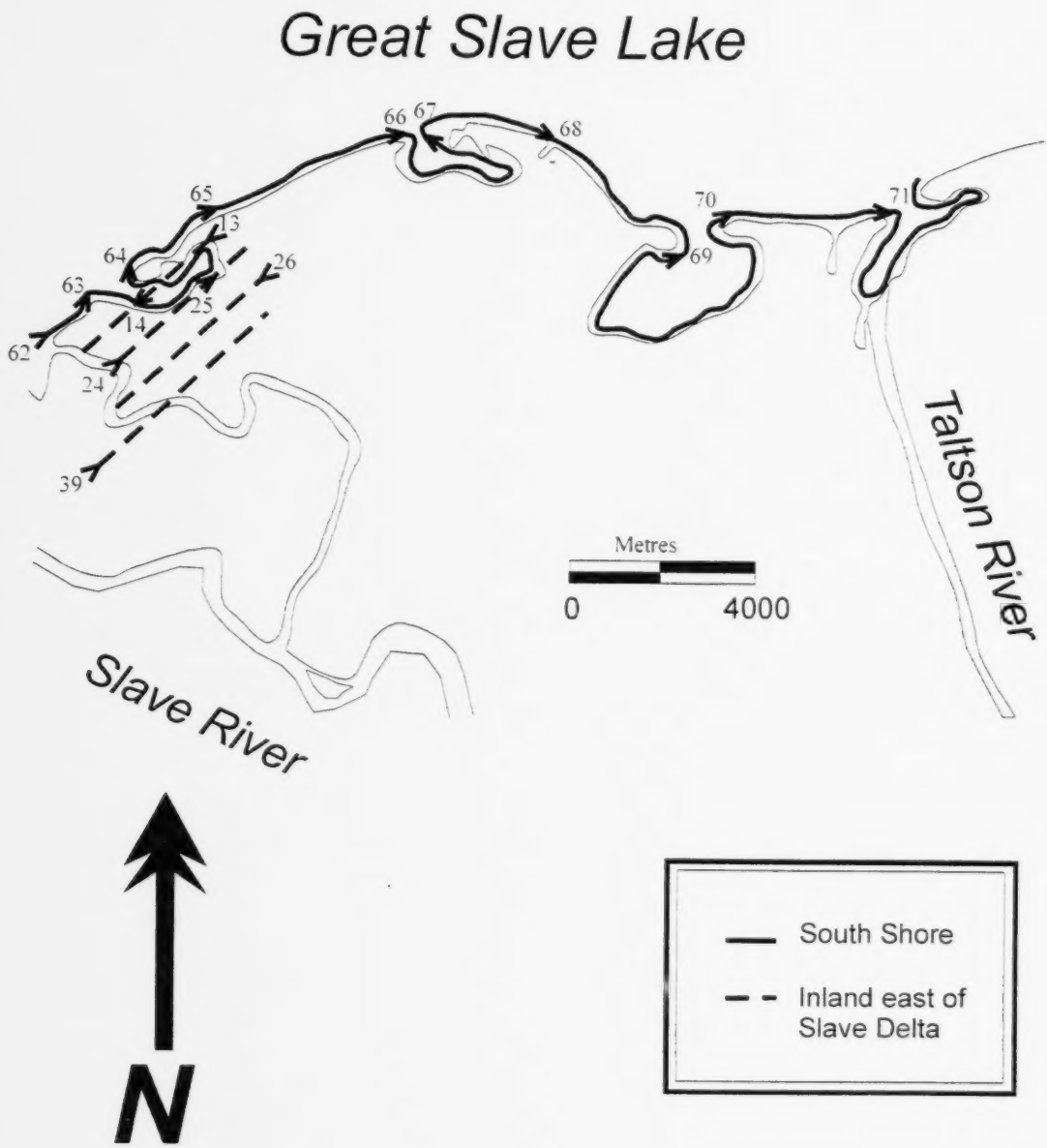


Figure 4. Transects flown, Slave River north of Fort Smith, spring 1983. Numbers indicate transect sections.

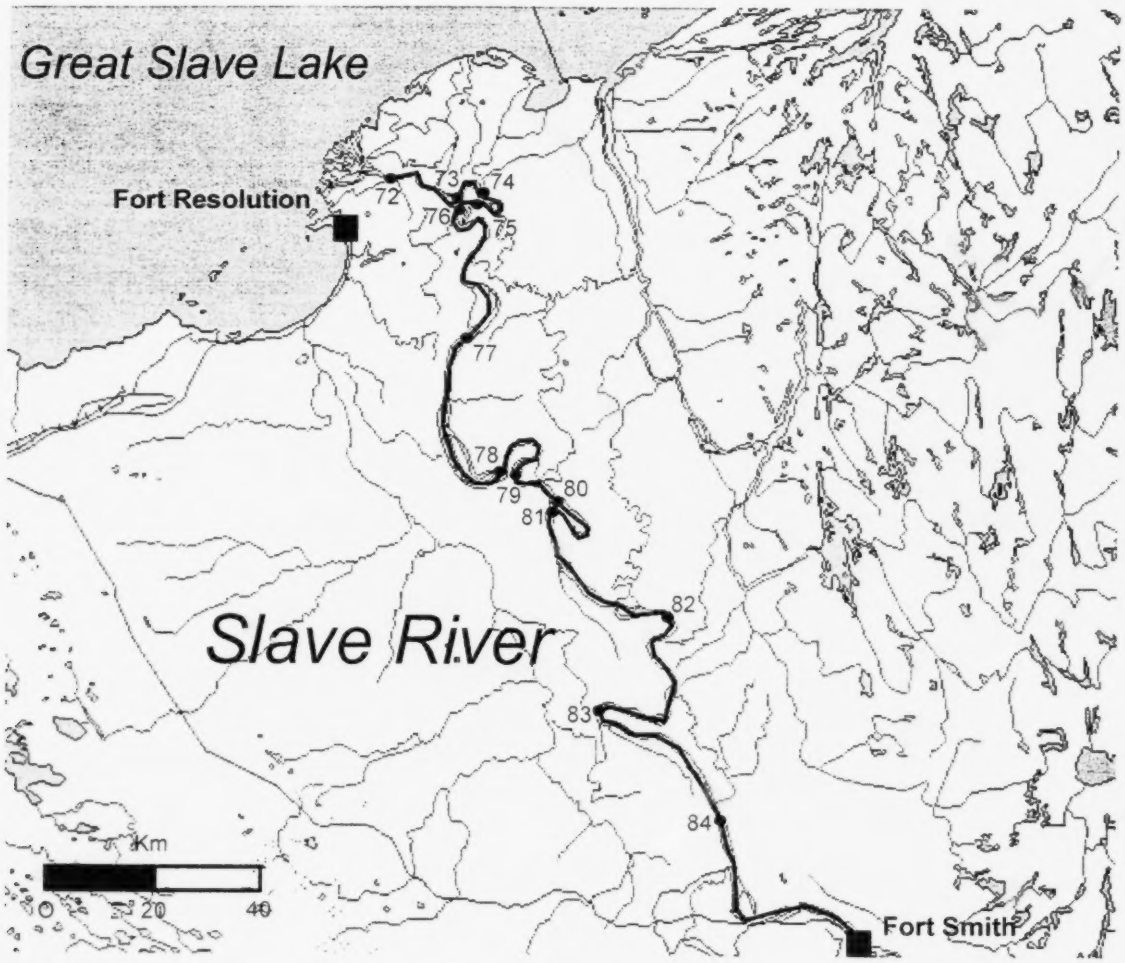


Figure 5. Transects flown, Slave River south of Fort Smith, 1983.

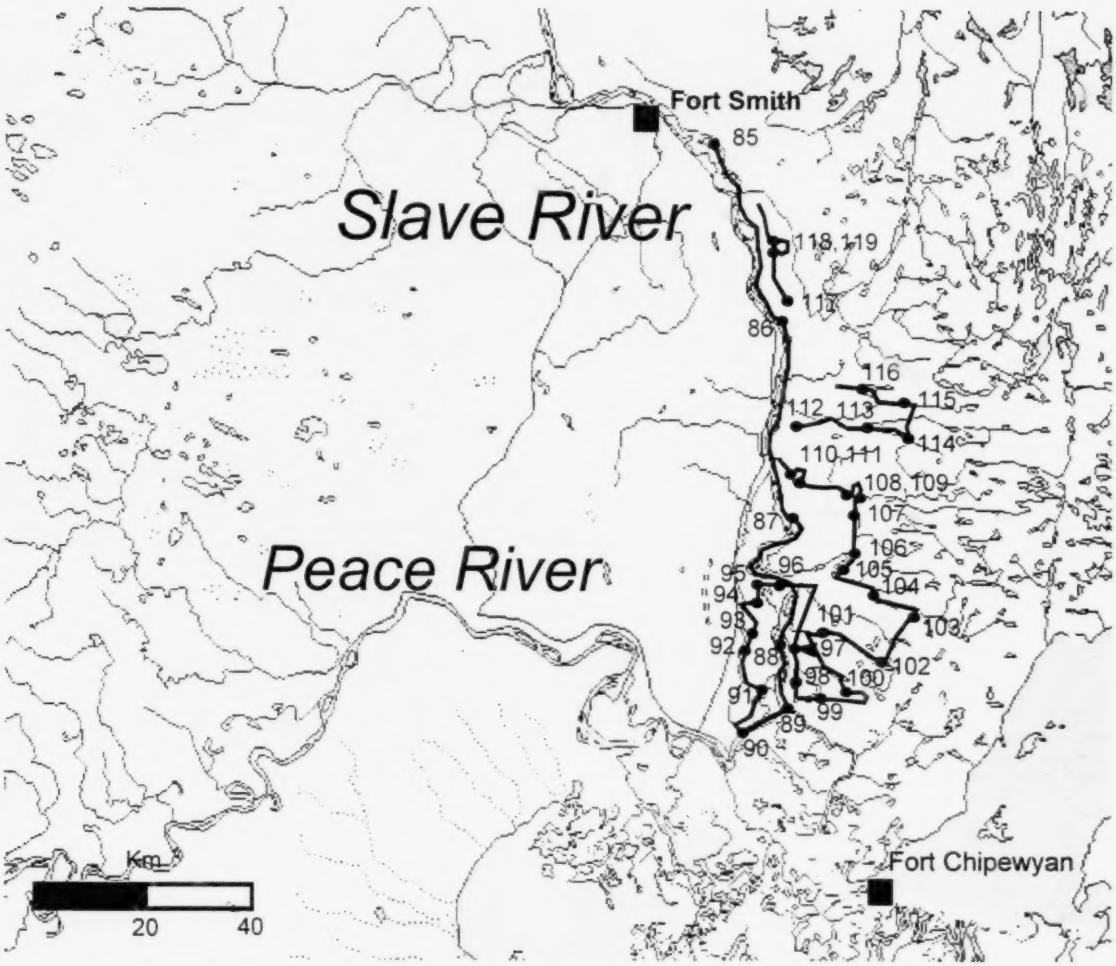
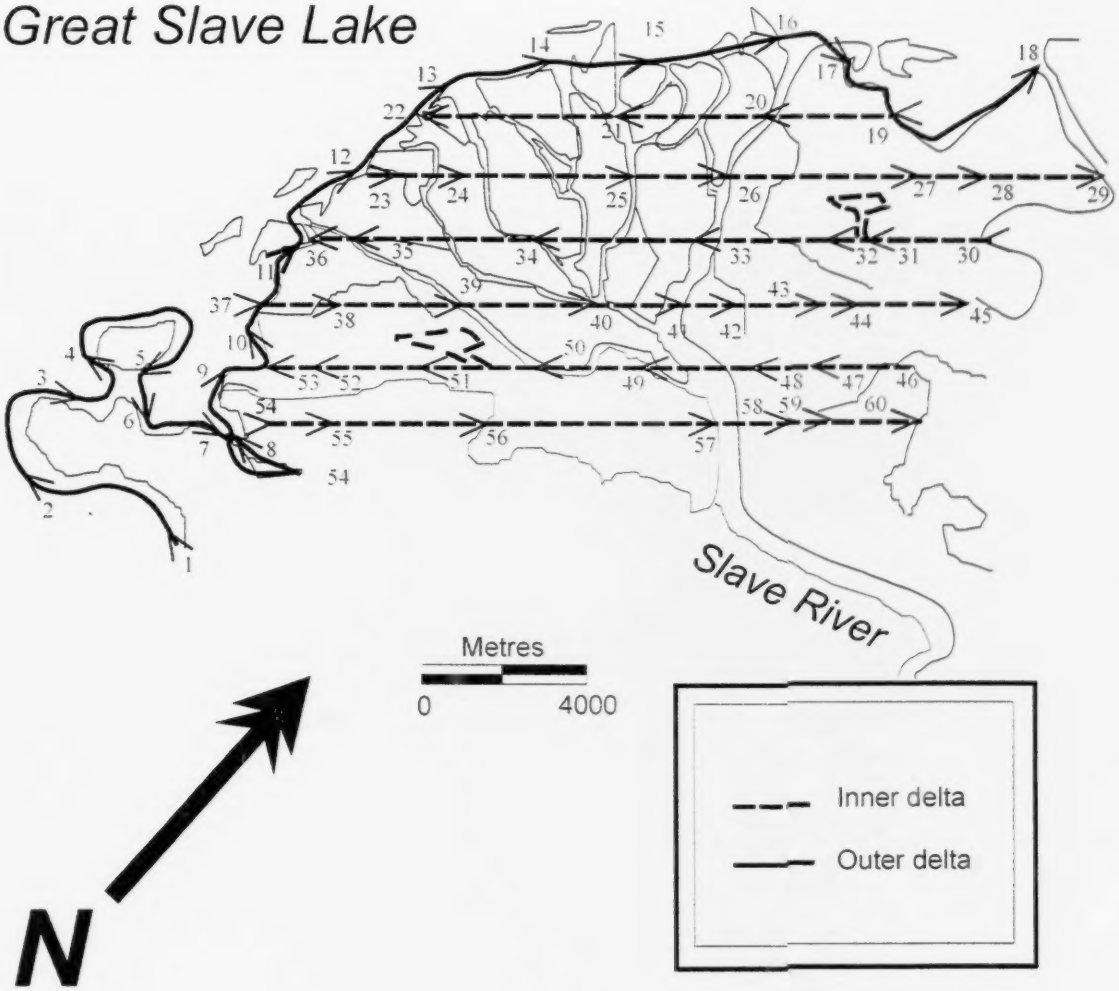


Figure 6. Transects flown during waterfowl brood production surveys, Slave River Delta, summer 1983.



4.0. RESULTS AND DISCUSSION

4.2. Spring waterbird surveys

4.2.1. Slave River Study Area

Results of these surveys show that numbers of geese, Tundra Swans and ducks peaked in the Slave River Study Area on 25 May (Tables 3, 4, 5 and 6). Peaks were, however, reached in Slave River Delta and Slave River South, including adjacent lakes and other waterbodies on 18 May. This suggests that these areas were open to access by waterfowl earlier than the rest of the study area. Indeed Great Slave Lake was still frozen at the time of the 18 May survey. The highest goose, Tundra Swan and total waterfowl numbers and densities were found along the south shore Great Slave Lake (Tables 3 and 6). Although the highest density of ducks was found on Ring Lake, the highest numbers were found on the south shore of Great Slave Lake (Table 5). These results suggest that the south shore of Great Slave Lake is an important staging area especially for arctic-nesting geese and Tundra Swans. Full details on species and numbers observed are presented by region.

4.2.2. Slave River Delta

When compared to the other two years of surveys, exceptionally large numbers of waterfowl staged in the Slave River Delta in 1983. Comments by the residents of Fort Resolution concurred with this observation (D. Young pers. comm.). Table 8 compares the numbers of waterfowl observed on each survey in 1983 to those seen on surveys conducted over a similar period in 1979 and 1984. Appendix 2 presents the numbers of each species seen during surveys of the Slave River Delta in 1983.

Waterbird use of the delta varied both spatially and temporally. Waterbird numbers were at their highest on the first survey on 18-19 May. The only species groups to peak after that date were the diving ducks on the second survey (25-26 May) and shorebirds on the last survey (1 June). Most of the waterbirds observed on the first survey were on the outer portion of the delta, evenly divided between the channels near the outer edge of the delta and the shore of Great Slave Lake (Figures 7-12). On the second and third surveys, however, most observations were from the shore of the lake. This change in distribution is probably a reflection of increasing open water on Great Slave Lake. Most of the shorebirds were on the shore of the lake (Figure 12). Of these, two-thirds were on extensive offshore mudflats (transect section 56).

Table 3. Goose numbers and densities, Slave River Study Area, spring 1983.

	18-19 May			25-26 May			1 June		
	on transect		on &off	on transect		on & off	on transect		on & off
Location	number	density[a]	transect	number	density	transect	number	density	transect
S.R. Delta	7644	45.11	12864	1607	9.48	6084	109	0.64	140
S Shore	fr[b]	fr	fr	43041	409.21	52006	10302	97.95	12666
E. of Delta	1877	45.71	2407	2321	56.53	3821	487	11.86	507
S.R. North	64	0.22	199	29	0.10	59	ns[c]	ns	ns
Hook Lake	0	0	0	1045	45.57	1045	ns	ns	ns
Ring Lake	0	0	0	448	43.24	448	255	24.61	255
S.R. South	22	0.16	66	11	0.08	26	ns	ns	ns
Major lakes	5100	157.26	5100	3558	141.19	3558	ns	ns	ns
Other bodies	0	0	3	30	0.16	95	ns	ns	ns
Totals	**14707**	**15.93**	**20639**	**52090**	**52.57**	**67142**	**11153**	**25.37**	**13568**

[a] birds/km ; [b] fr = frozen; [c] ns = not surveyed

Table 4. Tundra Swan numbers and densities, Slave River Study Area, spring 1983.

	18-19 May			25-26 May			1 June		
	on transect		on &off	on transect		on & off	on transect		on & off
Location	number	density[a]	transect	number	density	transect	number	density	transect
S.R. Delta	662	3.91	1236	302	1.78	648	335	1.98	628
S. Shore	fr[b]	fr	fr	3442	32.72	3558	2080	19.78	3172
E. of Delta	77	1.88	127	810	19.73	827	247	6.02	485
S.R. North	11	0.04	11	41	0.14	41	ns[c]	ns	ns
Hook Lake	5	0.22	5	26	1.13	26	ns	ns	ns
Ring Lake	6	0.58	6	168	16.22	168	12	1.16	12
S.R. South	4	0.03	4	38	0.27	40	ns	ns	ns
Major lakes	0	0	0	19	0.75	19	ns	ns	ns
Other bodies	1	0.00	1	8	0.04	8	ns	ns	ns
Totals	**766**	**0.83**	**1390**	**4854**	**4.90**	**5335**	**2674**	**6.08**	**4297**

[a] birds/km ; [b] fr= frozen; [c] ns= not surveyed

Table 5. Duck numbers and densities, Slave River Study Area, spring 1983.

	18-19 May			25-26 May			1 June		
	on transect		on &off	on transect		on & off	on transect		on & off
Location	number	density[a]	transect	number	density	transect	number	density	transect
S.R. Delta	2694	15.90	3478	2728	16.10	3112	485	2.86	639
S. Shore	fr[b]	fr	fr	5868	55.79	7802	1045	9.94	1296
E. of Delta	1724	41.99	1912	2345	57.11	2674	419	10.20	563
S.R. North	1244	4.28	1332	2540	8.73	2778	ns[c]	ns	ns
Hook Lake	543	23.68	546	837	36.50	1187	ns	ns	ns
Ring Lake	294	28.38	296	742	71.62	742	208	20.08	210
S.R. South	328	2.34	369	248	1.77	284	ns	ns	ns
Major lakes	750	51.19	750	638	25.32	638	ns	ns	ns
Other bodies	2579	11.96	2616	1513	8.16	1599	ns	ns	ns
Totals	10156	11.00	11299	17459	17.62	20816	2157	4.91	2708

[a] birds/km ; [b] fr = frozen; [c] ns = not surveyed

Table 6. Total waterfowl numbers and densities, Slave River Study Area, spring 1983.

	18-19 May			25-26 May			1 June		
	on transect		on &off	on transect		on & off	on transect		on & off
Location	**number**	**density[a]**	**transect**	**number**	**density**	**transect**	**number**	**density**	**transect**
S.R. Delta	11000	64.92	17578	4637	27.36	9844	929	5.48	1407
S. Shore	fr[b]	fr	fr	52351	497.72	63366	13427	127.70	17134
E. of Delta	3678	89.58	4446	5476	133.37	7322	1153	28.08	1555
S.R. North	1319	4.54	1542	2610	8.97	2878	ns[c]	ns	ns
Hook Lake	548	23.90	551	1908	83.20	2258	ns	ns	ns
Ring Lake	300	28.96	302	1358	131.08	1358	475	45.85	477
S.R. South	354	2.53	439	297	2.12	350	ns	ns	ns
Major lakes	5850	208.45	5850	4215	167.26	4215	ns	ns	ns
Other bodies	2580	11.96	2620	1551	8.36	1702	ns	ns	ns
Totals	**25629**	**27.79**	**33328**	**74403**	**75.09**	**93293**	**15984**	**36.36**	**20573**

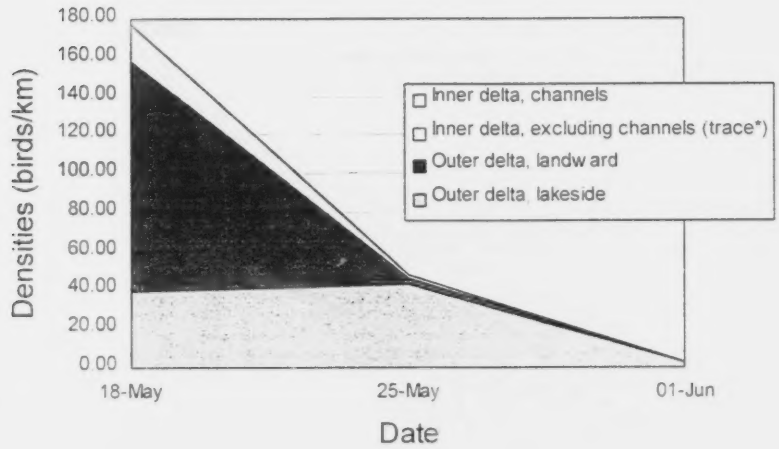
[a] birds/km ; [b] fr = frozen; [c] ns = not surveyed

Table 7. Number and density of birds by species group, Slave River Delta, spring 1983.

	18-19 May			25-26 May			1 June		
	on transect		on &off	on transect		on & off	on transect		on & off
Species group	**number**	**density[a]**	**transect**	**number**	**density**	**transect**	**number**	**density**	**transect**
Loons	2	0.01	2	11	0.06	11	7	0.04	7
Grebes	7	0.04	7	9	0.05	9	0	0.00	1
Dark geese	5336	31.49	10556	1487	8.78	4239	97	0.57	97
Light geese	2308	13.62	2308	120	0.71	1845	12	0.07	43
Total geese	**7644**	**45.11**	**12864**	**1607**	**9.48**	**6084**	**109**	**0.64**	**140**
Tundra swans	**662**	**3.91**	**1236**	**302**	**1.78**	**648**	**335**	**1.98**	**628**
Dabbling ducks	801	4.73	851	458	2.70	466	156	0.92	176
Diving ducks	242	1.43	247	1569	9.26	1586	186	1.10	205
Mergansers	4	0.02	4	12	0.07	12	6	0.04	6
Unid. Ducks	1647	9.72	2376	689	4.07	1048	137	0.81	252
Total ducks	**2694**	**15.90**	**3478**	**2728**	**16.10**	**3112**	**485**	**2.86**	**639**
Total waterfowl	**11000**	**64.92**	**17578**	**4637**	**27.37**	**9844**	**929**	**5.48**	**1407**
Shorebirds	37	0.22	37	848	5.00	877	1196	7.06	1196
Gulls	11	0.06	11	23	0.14	27	19	0.11	30

[a] birds/km

Figure 7. Phenology and habitat use,
Dark Geese, Slave River Delta, spring 1983.



* Density of less than 2.0 birds/km on all days (may not show on graph)

Figure 8. Phenology and habitat use, white geese,
Slave River Delta, spring 1983

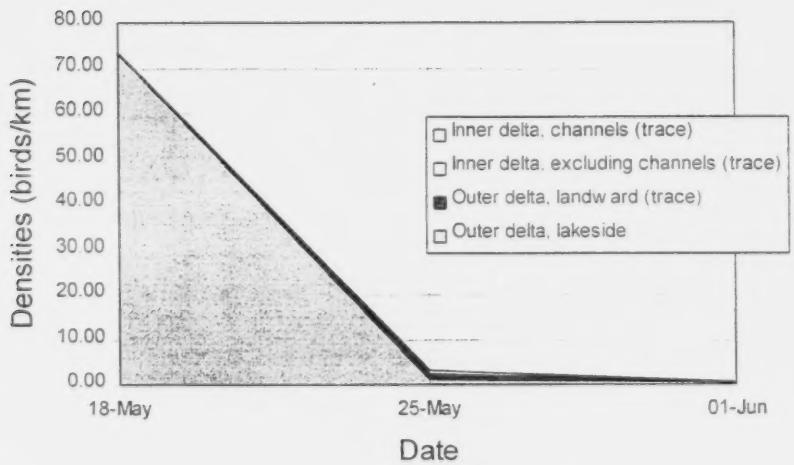


Figure 9. Phenology and habitat use,
Tundra Swans, Slave River Delta, spring 1983.

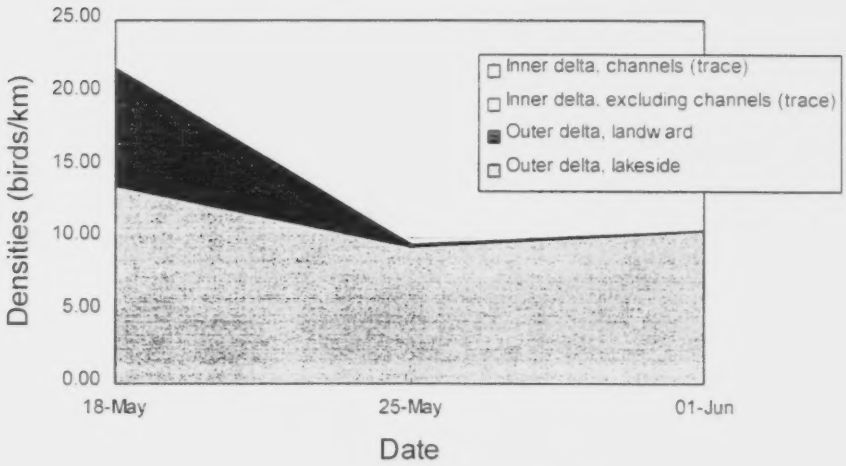


Figure 10. Phenology and habitat use,
dabbling ducks, Slave River Delta, spring 1983.

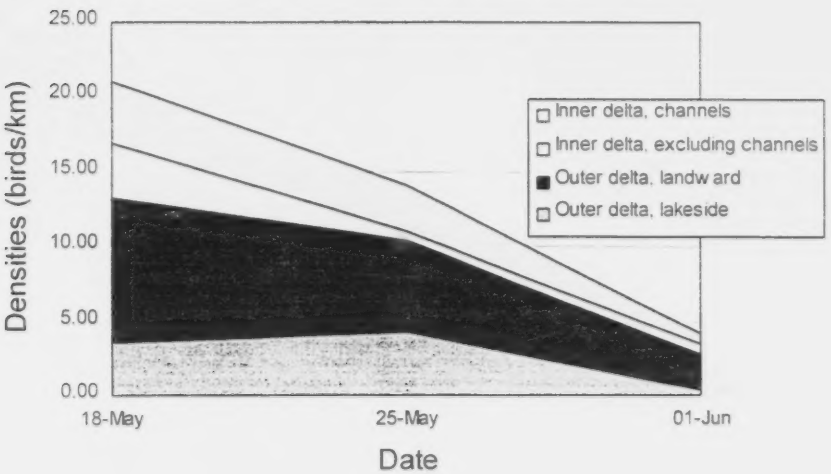


Figure 11. Phenology and habitat use, diving ducks, Slave River Delta, spring 1983.

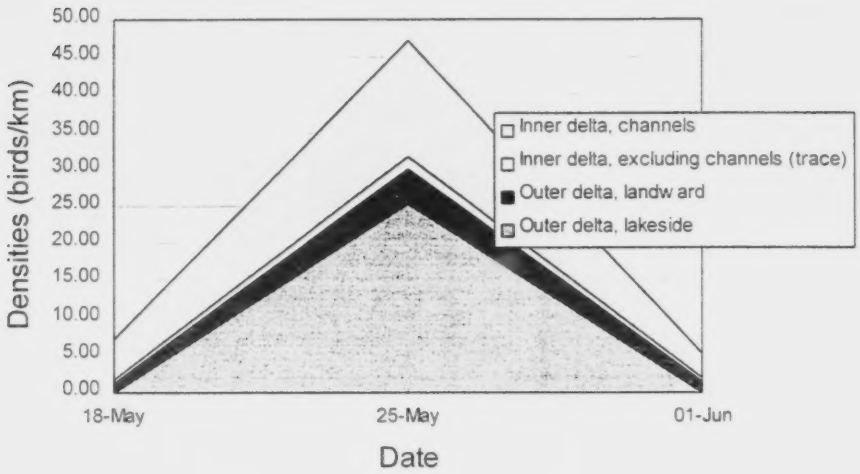
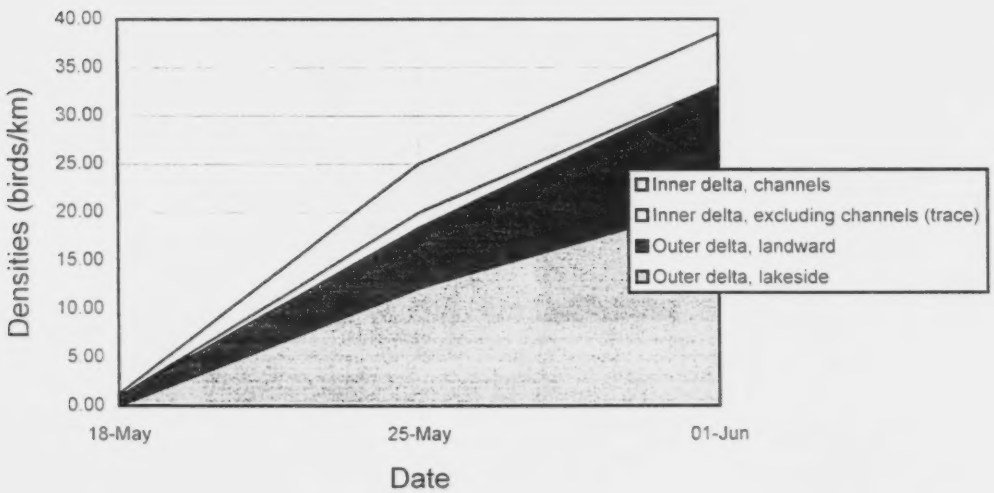


Figure 12. Phenology and habitat use, shorebirds, Slave River Delta, spring 1983.



4.2.2.1. Comparison with other years

In 1983, waterfowl numbers peaked on the delta on 18 May. The 1979 peak (20 May) was similar to that of 1983, while the 1984 peak occurred over two weeks earlier on 3 May (EMA 1984). Indeed most of the 1984 migration was over by the time surveys began in 1979 and 1983. The relatively large number of waterfowl recorded in 1983 was primarily due to large numbers of geese.

Table 8. Comparison of spring waterfowl surveys, Slave River Delta, 1979, 1983 and 1984 (on and off transect data combined).

Species group	Surveys by year	Dates surveyed							
	1979[a]	**ns**	**14 May**	**17 May**	**20 May**	**22 May**	**25 May**	**30 May**	**02 Jun**
	1983[b]	**ns**	**ns**	**18-19 May**	**ns**	**ns**	**25 May**	**ns**	**01 Jun**
	1984[c]	**3 May**	**ns**	**16-17 May**	**ns**	**23 May**	**ns**	**30 May**	**ns**
Swans	1979	ns	174	386	390	752	837	1339	548
	1983	ns	ns	1236	ns	ns	648	ns	628
	1984	6	ns	35	ns	89	ns	65	ns
Geese	1979	ns	292	1607	3715	2255	593	75	17
	1983	ns	ns	12812	ns	ns	5941	ns	110
	1984	1218	ns	45	ns	5	ns	7	ns
Ducks	1979	ns	3435	1166	1569	1320	1724	1779	472
	1983	ns	ns	2319	ns	ns	1742	ns	156
	1984	753	ns	509	ns	510	ns	424	ns
Waterfowl	1979	ns	3901	3159	5674	4327	3154	3193	1037
	1983	ns	ns	16367	ns	ns	8266	ns	822
	1984	1977	ns	589	ns	604	ns	496	ns

[a] Thompson *et al.* 1979; [b] This study; [c] EMA (1984); ns= not surveyed

4.2.3. South Shore of Great Slave Lake

Reconnaissance flights on 12 and 18 May showed no open water along the south shore of Great Slave Lake delaying our first aerial surveys until 25 May. This and the subsequent 1 June survey, revealed large numbers of waterfowl in this region as compared to other regions of the study area (Tables 3, 4, 5 and 6). Geese dominated the waterfowl totals on both surveys (Table 9). The bays showed heavier waterfowl use than the exposed shoreline with respective densities of 722.08 and 222.99 birds/km on 25 May. Shorebirds similarly favoured the bays over exposed shorelines with respective densities on 1 June of 8.91 and 0.32 birds/km. As in the delta, shorebirds numbers were still increasing when the last survey was conducted.

Table 9. Number and density of birds by species group, shore of Great Slave Lake, spring 1983 (Jean River to Talston Bay).

	18-19 May			25-26 May			1 June		
	on transect		on &off	on transect		on &off	on transect		on &off
Species group	number	density[a]	transect	transect	density	transect	number	density	transect
Loons	--------lake frozen--------			4	0.04		0	0.00	
Grebes	--------lake frozen--------			2	0.02		2	0.02	
White Geese	--------lake frozen--------			16819	159.91		5036	47.88	
Dark Geese	--------lake frozen--------			26222	249.31		5266	50.07	
Total geese	**--------lake frozen--------**			**43041**	**409.21**	**52006**	**10302**	**97.95**	**12666**
Tundra Swans	**--------lake frozen--------**			**3442**	**32.72**	**3558**	**2080**	**19.78**	**3172**
Dabblers	--------lake frozen--------			1275	12.12		152	1.45	
Divers	--------lake frozen--------			1246	11.85		289	2.75	
Mergansers	--------lake frozen--------			105	1.00		42	0.40	
Unid. Ducks	--------lake frozen--------			3242	30.82		562	5.34	
Total ducks	**--------lake frozen--------**			**5868**	**55.79**	**7802**	**1045**	**9.94**	**1296**
Total waterfowl	**--------lake frozen--------**			**52351**	**497.72**	**63316**	**13427**	**128.06**	**17134**
Shorebirds	--------lake frozen--------			485	4.61		533	5.07	
Gulls	--------lake frozen--------			115	1.09		54	0.51	

[a] Birds/km

4.2.3.1. Comparison with other years

On 25 May 1983 (the peak date) 63521 waterfowl were found along the shoreline east of the Slave River Delta. In comparison there were only 17827 waterfowl at their peak on the same date in 1979 (Table 10). The only species group recorded in greater numbers in 1979 was the Tundra Swan (4568 versus 3558).

Table 10. Comparison of spring waterfowl surveys, south shore of Great Slave Lake (Jean River to Talston Bay), 1979 and 1983 (on and off transect data combined).

Species Group	Year	24 May	25 May	30 May	1 Jun	2 Jun
Geese	1979[a]	7060	9664	2545		310
	1983[b]		52006		12666	
Swans	1979	4250	4568	2761		1383
	1983		3558		3172	
Ducks	1979	3161	3595	1926		1158
	1983		7802		1296	
Waterfowl	1979	14471	17827	7232		2851
	1983		63521		17176	

[a] Thompson et al. 1979; [b] This study

4.2.4. Inland areas east of the Slave River Delta

The inland area east of the delta was less used by waterfowl than the south shore but more intensively used (had higher densities) than the delta (Tables 3, 4, 5 and 6). Waterfowl numbers were divided nearly equally between geese and ducks on all three surveys (Table 11).

Table 11. Number and density of birds by species group, transects east of the Slave River Delta, spring 1983.

	18-19 May			25-26 May			1 June		
	on transect		on & off	on transect		on & off	on transect		on & off
Species group	number	density[a]	transect	transect	density	transect	number	density	transect
Dark Geese	1677	40.84	1677	1821	44.35	2821	462	11.25	482
White Geese	200	4.87	730	500	12.18	1000	25	0.61	25
Total geese	**1877**	**45.71**	**2407**	**2321**	**56.53**	**3821**	**487**	**11.86**	**507**
Tundra Swans	**77**	**1.88**	**127**	**810**	**19.73**	**827**	**247**	**6.02**	**485**
Dabblers	71	1.73	71	67	01.63	67	101	2.46	106
Divers	26	0.63	261	1059	25.79	1099	73	1.78	177
Mergansers	45	1.10	45	0	0	0	10	0.24	10
Unid. ducks	1582	38.53	1535	1219	29.69	1508	235	5.72	270
Total ducks	**1724**	**41.99**	**1912**	**2345**	**57.11**	**2674**	**419**	**10.20**	**563**
Total waterfowl	**3678**	**89.58**	**4446**	**5476**	**133.37**	**7322**	**1153**	**28.08**	**1555**

[a] Birds/km

4.2.5 Slave River

The Slave River had the lowest densities of waterfowl in the entire study area (Tables 12 and 13). We recorded a maximum density of 8.97 birds/km (2610 individuals) north of Fort Smith and an even lower density of 2.52 birds/km to the south. The waterfowl migration peaked a week earlier in the south than in the north.

Table 12. Numbers and densities of birds by species group, Slave River North, spring 1983.

	12 May			18-19 May			25-26 May			1 June		
	on transect		on & off	on transect		on & off	on transect		on & off	on transect		on & off
Species group	number	density[a]	transect	number	density	transect	number	density	transect	number	density	transect
Loons	ns	ns	ns	18	0.06	18	10	0.03	10	ns	ns	ns
Grebes	ns	ns	ns	14	0.05	14	6	0.02	6	ns	ns	ns
Dark geese	ns	ns	ns	64	0.22	199	29	0.10	59	ns	ns	ns
Light geese	ns	ns	ns	0	0	0	0	0	0	ns	ns	ns
Total geese	ns	ns	ns	**64**	**0.22**	**199**	**29**	**0.10**	**59**	ns	ns	ns
Swans	ns	ns	ns	**11**	**0.04**	**11**	**41**	**0.14**	**41**	ns	ns	ns
Dab. ducks	ns	ns	ns	351	1.21	353	346	1.19	348	ns	ns	ns
Diving ducks	ns	ns	ns	415	1.43	437	1787	6.14	1804	ns	ns	ns
Mergansers	ns	ns	ns	21	0.07	21	25	0.09	25	ns	ns	ns
Unid. ducks	ns	ns	ns	457	1.57	521	382	1.31	601	ns	ns	ns
Total ducks	ns	ns	ns	**1244**	**4.28**	**1332**	**2540**	**8.73**	**2778**	ns	ns	ns
Waterfowl	ns	ns	ns	**1319**	**4.53**	**1542**	**2610**	**8.97**	**2878**	ns	ns	ns
Shorebirds	ns	ns	ns	107	0.37	107	666	2.29	681	ns	ns	ns
Gulls	ns	ns	ns	172	0.59	394	181	0.62	197	ns	ns	ns

[a] Birds/km ; [b] ns = not surveyed

Table 13. Numbers and densities of birds by species group, Slave River South, spring 1983.

	12 May			18-19 May			25-26 May			1 June		
	on transect		on & off	on transect		on & off	on transect		on & off	on transect		on & off
Species group	number	density[a]	transect	number	density	transect	number	density	transect	number	density	transect
Loons	8	0.06	8	2	0.01	2	1	0.01	1	ns	ns	ns
Grebes	0	0	0	2	0.01	2	0	0	0	ns	ns	ns
Dark geese	14	0.10	69	22	0.16	62	11	0.08	11	ns	ns	ns
Light geese	0	0	0	0	0	4	0	0	15	ns	ns	ns
Total geese	**14**	**0.10**	**69**	**22**	**0.16**	**66**	**11**	**0.08**	**26**	ns	ns	ns
Swans	**0**	**0**	**0**	**4**	**0.03**	**4**	**38**	**0.27**	**40**	ns	ns	ns
Dab. ducks	25	0.18	25	83	0.59	83	83	0.59	83	ns	ns	ns
Diving ducks	10	0.07	10	162	1.15	172	91	0.65	91	ns	ns	ns
Mergansers	33	0.24	33	27	0.19	27	5	0.04	5	ns	ns	ns
Unid. ducks	38	0.27	46	56	0.40	87	69	0.49	105	ns	ns	ns
Total ducks	**106**	**0.75**	**114**	**328**	**2.34**	**369**	**248**	**1.77**	**284**	ns	ns	ns
Waterfowl	**120**	**0.85**	**183**	**354**	**2.52**	**439**	**297**	**2.12**	**350**	ns	ns	ns
Shorebirds	0	0	0	0	0	0	54	0.38	69	ns	ns	ns
Gulls	39	0.28	68	36	0.26	39	65	0.46	74	ns	ns	ns

[a] Birds/km ; [b] ns = not surveyed

4.2.5.1. Comparison with other years

Waterfowl numbers peaked on the river at approximately the same time in both years: 25-26 May in 1983 and 23 May in 1984 (Table 14). Peak numbers were, however, greater in 1983 with 3225 waterfowl observed on 25-26 May compared to 970 on 23 May 1984. This difference was undoubtedly due to the late break up in 1983 which resulted in a delay and concentration of migration.

Table 14. Comparison of spring waterfowl surveys, Slave River, 1983 and 1984 (on and off transect data combined).

Species group	Year	16-17 May	19 May	23 May	25-26 May	30 May
Total geese	1983[a]		265		85	
	1984[b]	77		36		67
Tundra swans	1983		15		81	
	1984	0		0		2
Dabbling ducks	1983		436		429	
	1984	92		191		565
Diving ducks	1983		602		1894	
	1984	182		743		52
Total ducks	1983		1646		3029	
	1984	274		934		617
Total waterfowl	**1983**		**1974**		**3225**	
	1984	**351**		**970**		**686**
Total shorebirds	1983		107		750	
	1984	4		0		38

[a]This study; [b]EMA 1984

4.2.6. Inland areas adjacent the Slave River

We flew transects at Ring (10km) and Hook (23km) lakes in the Northwest Territories, and an additional 1363km of transects around lakes and other wetlands in Alberta. Ring Lake was used more by waterfowl (maximum density 131.08 birds/km) than was Hook Lake (maximum density 83.21 birds/km) (Tables 15 and 16). In Alberta, lakes adjacent the Slave River were more heavily used by waterfowl than the small streams and meadows with the maximum respective densities of 180.39 and 11.97 birds/km on 19 May, (Tables 17 and 18). This difference was especially marked for geese which were rarely recorded on other inland waterbodies.

Table 15. Numbers and densities of birds by species group, Hook Lake, spring 1983.

	12 May			18-19 May			25-26 May			1 June		
	on transect		on & off	on transect		on & off	on transect		on & off	on transect		on & off
Species group	number	density[a]	transect	number	density	transect	number	density	transect	number	density	transect
Loons	4	0.17	4	13	0.57	13	1	0.04	1	ns	ns	ns
Grebes	26	1.13	26	36	1.57	36	5	0.22	5	ns	ns	ns
Dark geese	0	0	0	0	0	0	870	37.94	870	ns	ns	ns
Light geese	0	0	0	0	0	0	175	7.63	175	ns	ns	ns
Total geese	**0**	**0**	**0**	**0**	**0**	**0**	**1045**	**45.57**	**1045**	ns	ns	ns
Swans	**5**	**0.22**	**5**	**0**	**0**	**0**	**26**	**1.13**	**26**	ns	ns	ns
Dab. Ducks	57	2.49	57	41	1.79	41	149	6.50	149	ns	ns	ns
Diving ducks	143	6.24	143	459	20.02	459	254	11.08	254	ns	ns	ns
Mergansers	0	0	0	9	0.39	9	0	0	0	ns	ns	ns
Unid. Ducks	82	3.58	105	34	1.48	37	434	18.93	784	ns	ns	ns
Total ducks	**282**	**12.30**	**305**	**543**	**23.68**	**546**	**837**	**36.50**	**1187**	ns	ns	ns
Waterfowl	**287**	**12.52**	**310**	**543**	**23.68**	**546**	**1908**	**83.21**	**2258**	ns	ns	ns
Shorebirds	2	0.09	2	0	0	0	526	22.94	526	ns	ns	ns
Gulls	54	2.35	54	8	0.35	8	24	1.05	24	ns	ns	ns

[a] Birds/km ; [b] ns = not surveyed

Table 16. Numbers and densities of birds by species group, Ring Lake, spring 1983.

	12 May			18-19 May			25-26 May			1 June		
	on transect		on & off	on transect		on & off	on transect		on & off	on transect		on & off
Species group	number	density[a]	transect	number	density	transect	number	density	transect	number	density	transect
Loons	3	0.29	3	26	2.51	26	2	0.19	2	3	0.29	3
Grebes	18	1.74	18	2	0.19	2	3	0.29	3	2	0.19	2
Dark geese	0	0	0	0	0	0	448	43.24	448	205	19.79	205
Light geese	0	0	0	0	0	0	0	0	35	50	4.83	50
Total geese	**0**	**0**	**0**	**0**	**0**	**0**	**448**	**43.24**	**483**	**255**	**24.61**	**255**
Swans	**2**	**0.19**	**2**	**6**	**0.58**	**6**	**168**	**16.22**	**168**	**12**	**1.16**	**12**
Dab. Ducks	10	0.97	10	4	0.39	4	165	15.93	165	68	6.56	68
Diving ducks	95	9.17	95	171	16.51	173	238	22.97	238	111	10.71	111
Mergansers	16	1.54	16	2	0.19	2	6	0.58	6	12	1.16	12
Unid. Ducks	38	3.67	38	117	11.29	117	333	32.14	333	17	1.64	19
Total ducks	**159**	**15.35**	**159**	**294**	**28.38**	**296**	**742**	**71.62**	**742**	**208**	**20.08**	**210**
Waterfowl	**161**	**15.54**	**161**	**300**	**28.96**	**302**	**1358**	**131.08**	**1413**	**475**	**45.85**	**477**
Shorebirds	30	2.90	30	25	2.41	25	24	2.32	24	2	0.19	2
Gulls	0	0	0	0	0	0	14	1.35	14	7	0.68	7

[a] birds/km

Table 17. Numbers and densities of birds by species group, major inland lakes, spring 1983.

	12 May			18-19 May			25-26 May			1 June		
	on transect		on & off	on transect		on & off	on transect		on & off	on transect		on & off
Species group	number	density[a]	transect	number	density	transect	number	density	transect	number	density	transect
Loons	0	0	0	7	0.22	7	8	0.32	8	ns	ns	ns
Grebes	1	0.07	1	0	0.00	0	0	0.00	0	ns	ns	ns
Dark geese	0	0	0	5000	154.18	5000	2770	109.92	2770	ns	ns	ns
Light geese	0	0	0	100	3.08	100	818	32.46	818	ns	ns	ns
Total geese	**0**	**0**	**0**	**5100**	**157.26**	**5100**	**3558**	**141.19**	**3558**	ns	ns	ns
Swans	**0**	**0**	**0**	**0**	**0.00**	**0**	**19**	**0.75**	**19**	ns	ns	ns
Dab. ducks	96	7.13	96	0	0.00	0	152	6.03	152	ns	ns	ns
Diving ducks	0	0	0	24	0.74	24	20	0.79	20	ns	ns	ns
Mergansers	0	0	0	26	0.80	26	65	2.58	65	ns	ns	ns
Unid. ducks	593	44.06	593	700	21.58	700	401	15.91	401	ns	ns	ns
Total ducks	**689**	**51.19**	**689**	**750**	**23.13**	**750**	**638**	**25.32**	**638**	ns	ns	ns
Waterfowl	**689**	**51.19**	**689**	**5850**	**180.39**	**5850**	**4245**	**168.45**	**4245**	ns	ns	ns
Shorebirds	90	6.69	90	0	0.00	0	630	25.00	630	ns	ns	ns
Gulls	9	0.67	9	0	0.00	0	19	0.75	19	ns	ns	ns

[a] birds/km ; [b] ns = not surveyed

Table 18. Numbers and densities of birds by species group, other inland waterbodies, spring 1983.

	12 May			18-19 May			25-26 May			1 June		
	on transect		on & off	on transect		on & off	on transect		on & off	on transect		on & off
Species group	number	density[a]	transect	number	density	transect	number	density	transect	number	density	transect
Loons	130	0.60	139	54	0.25	56	8	0.04	8	ns	ns	ns
Grebes	20	0.09	20	21	0.10	21	19	0.10	19	ns	ns	ns
Dark geese	0	0.00	0	0	0.00	3	0	0.00	65	ns	ns	ns
Light geese	0	0.00	0	0	0.00	0	0	0.00	0	ns	ns	ns
Total geese	**0**	**0.00**	**0**	**0**	**0.00**	**3**	**30**	**0.16**	**95**	ns	ns	ns
Swans	0	0.00	0	1	0.00	1	8	0.04	8	ns	ns	ns
Dab. Ducks	786	3.62	786	478	2.22	478	197	1.06	197	ns	ns	ns
Diving ducks	578	2.66	578	1132	5.25	1132	722	3.89	725	ns	ns	ns
Mergansers	43	0.20	43	39	0.18	39	0	0.00	0	ns	ns	ns
Total ducks	**2019**	**9.30**	**2079**	**2579**	**11.96**	**2616**	**1513**	**8.16**	**1599**	ns	ns	ns
Waterfowl	**2019**	**9.30**	**2079**	**2580**	**11.97**	**2620**	**1521**	**8.20**	**1672**	ns	ns	ns
Shorebirds	285	1.31	295	264	1.22	264	55	0.30	57	ns	ns	ns
Gulls	232	1.07	232	251	1.16	251	224	1.21	224	ns	ns	ns

[a] Birds/km ; [b] ns = not surveyed

4.2. Waterfowl Brood Production Surveys

We observed 28 duck broods with 122 young on 18 July, and 27 broods with 130 young on 26 July 1983. Thompson *et al.* (1979) reported 47 broods and 201 young on 18 July 1979 along identical transects. This suggests that brood production was lower on the delta in 1983 than in 1978. The combined results of our surveys (Table 20, Figure 7) indicate differences in habitat preferences for brood rearing between dabbling and diving ducks. Dabbling duck broods appear to be relatively evenly distributed throughout the Delta, while diver broods were most abundant on ponds, with seven of 10 broods and 37 of 48 young in this habitat. Brood densities were similar to those found at Utikuma Lake, Alberta (Donaghey 1974) and Mills-Beaver Lakes, NWT (Kemper *et al.* 1975)

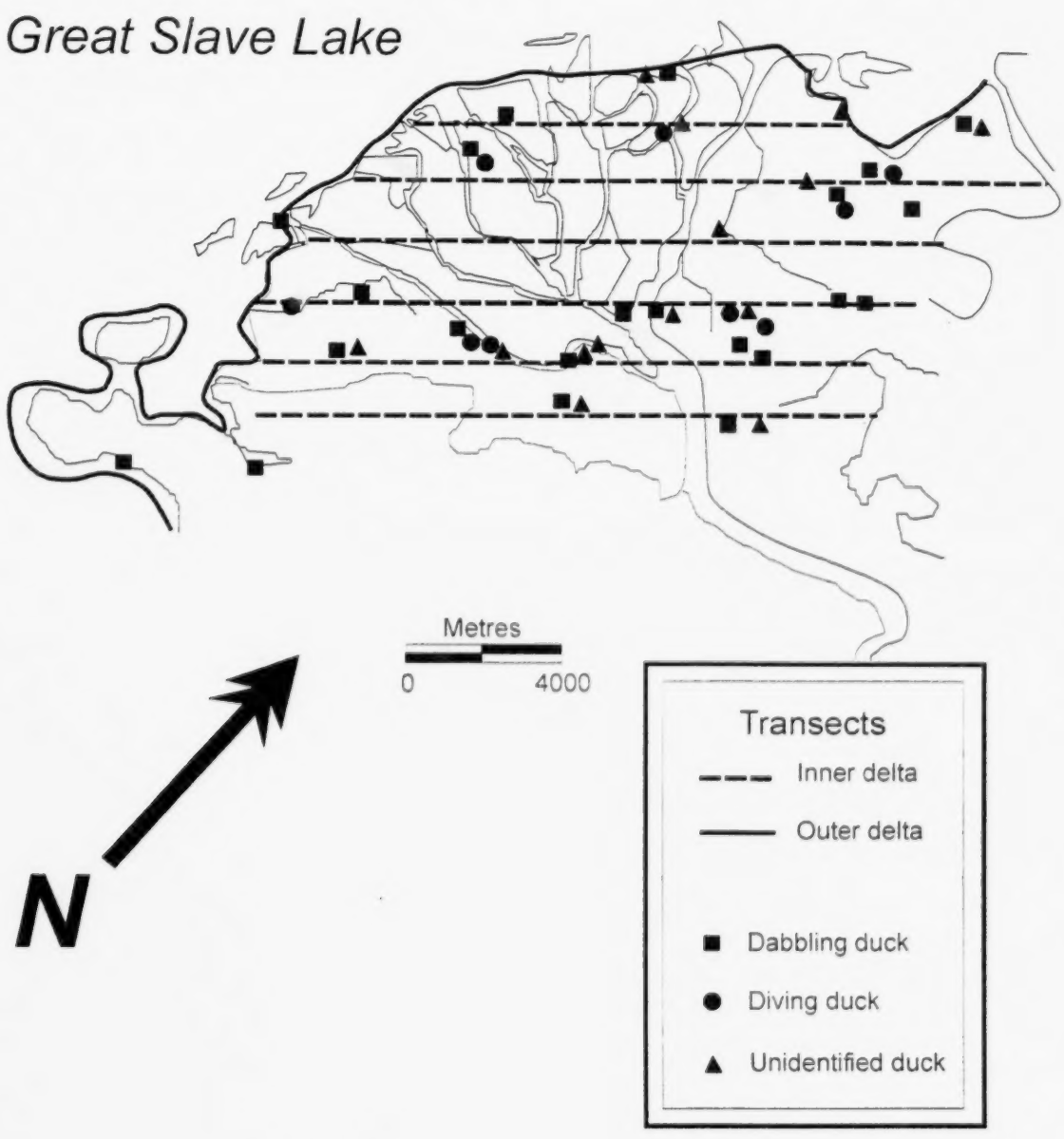
On 26 July 1983 sufficient flying time was available to survey Ring and Hook lakes to the south of the Delta. Only three broods, one diver brood of five young and two of unidentified ducks each with four young, were recorded on Ring Lake; Hook Lake had one unidentified duck brood of seven young. The respective densities were 0.28 and 0.04 broods/km. It thus appears that these two lakes are of little importance to waterfowl for brood rearing.

Table 19. Duck broods and young, Slave River Delta, summer 1983.

SPECIES	Outer Delta transect		Outer Delta line transects		Inner delta transects		Ponds		Total	
	Broods	Young	Broods	Young	Broods	Young	Broods	Young	Broods	Young
American Wigeon					1	4	1	4	2	8
Mallard			1	8	2	5	1	4	4	17
Northern Shoveler							1	7	1	7
Northern Pintail	3	14							3	14
Teal species	1	3					1	1	2	4
Unidentified dabbler	2	8			7	35	4	23	13	66
Total dabblers	**6**	**25**	**1**	**8**	**10**	**44**	**8**	**39**	**25**	**116**
Scaup sp.			1	5			4	16	5	21
Bufflehead							1	7	1	7
Unidentified diver			1	3	1	3	2	14	4	20
Total divers	**0**	**0**	**2**	**8**	**1**	**3**	**7**	**37**	**10**	**48**
Unidentified ducks	**1**	**7**	**0**	**0**	**8**	**29**	**5**	**25**	**14**	**61**
Total ducks	**7**	**32**	**3**	**16**	**19**	**76**	**20**	**101**	**49**	**225**

[a] Combined results of production surveys conducted on 16 and 27 July, 1983 (Gollop and Marshall 1954).

Figure 14. Distribution and abundance of broods and young, Slave River Delta, summer 1983.



5.0 CONCLUSIONS

Surveys conducted by the present authors, as well as those conducted by Thompson et al. (1979) and EMA (1984), show that the most important aspect of the Slave River Study Area for migrating waterbirds is the spring migration. Northward flowing rivers such as the Slave bring warmer waters from further south and are thus among the first waterbodies open in the spring. The Slave River Delta and the adjacent south shore appear particularly important as spring floodwaters are concentrated in the delta-lake interface.

Any change in water flow regimes would likely result in the changes in spring staging and breeding of waterbirds (Stevens 1971, Gill *et al.* 1977). If the spring flood is suppressed by a dam on the Slave river at Fort Smith, open water areas at the delta on the south shore of Great Slave Lake may not form as readily. The result could be a delay of the spring migration or perhaps alterations of migratory routes. Suppression of flooding would allow for the encroachment of woody vegetation at the expense of plants consumed by migrating and breeding waterfowl. A third effect would be the reduction in sediment load necessary to maintain the shoals and sandbars used for loafing and resting by migrating waterfowl and shorebirds. The overall results could be a decline in waterbird staging and breeding populations. The world's northernmost American White Pelican colony located at the Rapids of the Drowned near Fort Smith could also be negatively affected.

Hydrologists should determine how silt deposition and water flow regimes would be affected by any proposed hydroelectric development. Any perturbations need to be defined and evaluated before any consideration is given to a possible development on the Slave River. As powerlines would be an infrastructure associated with such a development, the examination of flight routes and levels of geese and ducks should also be determined minimize associated mortalities.

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Appendix 1. Transect section lengths of 1983 spring surveys, Slave River Study Area.

Transect section	Section length (km)	Transect section	Section length (km)	Transect section	Section length (km)	Transect section	Section length km)
Slave River Delta		40	3.61	64	5.47	105	4.46
1	9.84	41	2.97	65	11.67	113	7.23
2	0.29	42	1.45	66	12.27	115	10.92
3	1.56	43	1.31	67	7.75	**subtotal**	**29.66**
4	5.44	44	4.24	68	8.49	**Other inland waterbodies**	
5	6.27	45	1.40	69	17.99	90	10.01
6	1.56	46	1.44	70	8.41	91	8.98
7	2.27	47	4.33	71	16.27	92	2.62
8	2.50	48	5.68	**subtotal**	**105.18**	93	10.19
9	3.81	49	5.14	**Slave River North**		95	4.70
10	1.59	50	9.24	72	20.45	96	18.50
11	1.66	51	6.85	73	8.65	97	5.75
12	5.57	52	1.75	75	4.11	98	9.51
15	2.12	53	1.59	76	37.80	99	11.87
16	2.70	54	1.93	77	40.52	100	17.72
17	4.05	55	2.56	78	17.87	101	10.91
18	4.55	56	6.58	79	9.18	102	9.53
19	2.71	57	4.93	81	39.60	104	10.20
20	4.69	58	4.53	82	37.34	106	9.37
21	2.57	59	3.55	83	38.30	107	2.51
22	4.37	60	4.51	84	37.13	108	3.99
23	4.91	61	4.95	**subtotal**	**290.94**	109	10.77
27	2.90	**subtotal**	**193.83**	**Slave River South**		110	2.81
28	4.16	**West of Delta**		85	39.16	111	6.42
29	2.25	13	4.73	86	39.34	112	15.66
30	4.23	14	5.81	87	38.92	114	9.84
31	2.43	24	6.08	88	13.91	116	5.36
32	1.58	25	2.43	89	9.07	117	10.11
33	2.17	26	10.85	**subtotal**	**140.40**	118	5.92
34	2.70	39	11.16	**Hook L.- 80**	**22.93**	119	9.69
35	2.52	**subtotal**	**41.06**	**Ring L. - 74**	**10.36**	**subtotal**	**222.91**
36	2.30	**South Shore Great Slave**		**Inland Lakes**		**TOTAL**	**1057.26**
37	3.25	62	5.28	94	2.54		
38	3.78	63	11.59	103	4.51		

Appendix 2. Birds observed on the Slave River Delta in the spring of 1983.

Species	11 May[a]		18 May		25 May		1 June	
	on	on+off	on	on+off	on	on+off	on	on+off
Pacific Loon					9	9	2	2
Common Loon			2	2	2	2	5	5
Total loons			2	2	11	11	7	7
Horned Grebe					7	7		1
Red-necked Grebe			7	7	2	2		
Total grebes			7	7	9	9		1
Gr. White-fronted Goose					2	2	10	10
Canada Goose	93	108	781	3781	60	60	45	45
Dark geese			4555	6775	1425	4177	42	42
Total dark geese	93	108	5336	10556	1487	4239	97	97
Total light geese			2308	2308	120	1845	12	43
Total geese	93	108	7644	12864	1607	6084	109	140
Tundra Swan		1	662	1236	302	648	335	628
American Wigeon	30	30	189	189	117	121	25	25
Mallard	123	126	269	269	101	102	71	91
Blue-winged Teal					10	10	5	5
Northern Shoveler	2	2	15	15	25	25	40	40
Northern Pintail	6	6	22	22	166	166	4	4
Green-winged Teal			2	2	9	12	4	4
Unidentified teal			8	8	3	3		
Unidentified dabbler	308	309	296	346	27	27	7	7
Total dabbler	469	473	801	851	458	466	156	176
Canvasback	10	10	51	51	49	49	19	19
Redhead					2	2		
Ring-necked Duck			10	10	35	35	1	1
Unidentified scaup		1	110	112	1118	1135	82	94
Surf Scoter					42	42	6	6
White-winged Scoter							1	1
Unidentified scoter								6
Oldsquaw							5	5
Bufflehead			41	44	41	41	39	40
Unidentified goldeneye			21	21	25	25	3	3
Ruddy Duck			2	2	4	4	13	13
Unidentified diver	1	1	7	7	253	253	17	17
Total diver	11	12	242	247	1569	1586	186	205
Unidentified duck	182	219	1647	2376	689	1048	137	252
Total duck	662	704	2690	3474	2716	3100	479	633
Common Merganser	2	2	4	4	6	6	2	2
Red-breasted Merganser							4	4
Unidentified merganser					6	6		
Total merganser	2	2	4	4	12	12	6	6
Total waterfowl	757	815	11000	17578	4637	9644	929	1407

Appendix 2. Continued.

Species	11 May[a]		18 May		25 May		1 June	
	on	on+off	on	on+off	on	on+off	on	on+off
Osprey							1	1
Bald Eagle	2(1)[b]	2(1)	0(2)	1(2)	2	3(1)		
Unidentified eagle			1	1			(1)	(1)
Northern Harrier	2	2	11	11	6	7	1	3
Rough-legged Hawk	2	2	5	6	7	7	1	1
Unidentified hawk			3	4			1	2
American Kestrel			1	1				
Peregrine Falcon							1	1
American Coot					2	2	7	7
Sandhill Crane							2	2
Unidentified shorebirds	14	14	37	37	848	877	1196	1196
Bonaparte's Gull					3	3		
Glaucous Gull					1	1		
White-headed Gull	35	37	11	11	20	24	19	30
Total gulls	35	37	11	11	23	27	19	30
Short-Eared Owl			2	2				
Common Raven			8	8			11	12
Total species	12	14	25	25	31	31	33	34
Total individuals	813	873	11090	17671	5546	10788	2177	2671

[a] Partial survey only.
[b] young of the year in parentheses.

Appendix 3. Number of birds observed during brood production surveys, Slave River Delta, 18 and 26 July 1983.

Species	Date:	Number of adults (and young) observed by section											
	July	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-13
Red-necked Grebe	18												
	26												
Unidentified grebe	18												1
	26												
American White	18										2		
Pelican	26												
Canada Goose	18									2			
	26												
American Wigeon	18							14(3)					1
	26											4	3
Mallard	18												1
	26									1			2
Blue-winged Teal	18												
	26												1
Northern Shoveler	18												
	26												
Northern Pintail	18							3(1)				1(1)	
	26	1(12)											
Green-winged Teal	18												
	26												
Unidentified teal	18												
	26												
Unidentified	18							3					
dabbler	26							5				1	1
Canvasback	18												
	26												
Unidentified scaup	18												
	26												
Surf Scoter	18												
	26												
Bufflehead	18												
	26												
Common	18												
Goldeneye	26												4
Red-breasted	18												
Merganser	26												
Unidentified	18												
merganser	26												
Ruddy Duck	18												
	26												
Unidentified diver	18		1										2
	26												

Appendix 3. Continued.

Species	Date:	Number of adults (and young) observed by section											
	July	13-14	14-15	15-16	16-17	17-18	19-20	20-21	21-22	23-24	24-25	25-26	26-27
Red-necked Grebe	18												
	26											1	
Unidentified grebe	18												
	26												
American White	18												
Pelican	26												
Canada Goose	18												
	26												
American Wigeon	18			8	12				10				
	26			1						1	1		
Mallard	18		7	6					2(8)	2	13(1)		
	26		1						3		2		
Blue-winged Teal	18												
	26												
Northern Shoveler	18		1										
	26												
Northern Pintail	18								5				
	26												
Green-winged Teal	18									1			
	26			8						2		1	
Unidentified teal	18												
	26												
Unidentified	18			1(5)					5	3			
dabbler	26		3	1(3)			12		9		1(1)		1
Canvasback	18							1					
	26												
Unidentified scaup	18							1(5)	2				
	26										1		
Surf Scoter	18												
	26												
Bufflehead	18	1											
	26												
Common	18												
Goldeneye	26												
Red-breasted	18												
Merganser	26			3									
Unidentified	18												
merganser	26												
Ruddy Duck	18										3		
	26												
Unidentified diver	18			1					1	1	1		
	26			2						2			

Appendix 3. Continued.

Species	Date:	Number of adults (and young) observed by section										
	July	27-28	28-29	30-31	31-32	32-33	33-34	34-35	35-36	37-38	38-39	39-40	40-41
Red-necked Grebe	18												
	26												
Unidentified grebe	18					1					2		
	26												
American White	18												
Pelican	26												
Canada Goose	18												
	26												
American Wigeon	18	1			1					2			
	26	10				1							
Mallard	18	3			4								
	26	1		1(4)	1(4)								
Blue-winged Teal	18												
	26												
Northern Shoveler	18												
	26												
Northern Pintail	18												
	26												
Green-winged Teal	18												
	26												
Unidentified teal	18												
	26												
Unidentified	18	1					4				1(5)		
dabbler	26	1(4)		1(4)		1			4				1(2)
Canvasback	18												
	26	1											
Unidentified scaup	18	26		1	7								
	26	10(5)			4								
Surf Scoter	18												
	26												
Bufflehead	18										2		
	26					1							
Common	18												
Goldeneye	26												
Red-breasted	18												
Merganser	26												
Unidentified	18												
merganser	26												
Ruddy Duck	18												
	26												
Unidentified diver	18		1		1			3					
	26	4						1		1			

Appendix 3. Continued.

Species	Date:	Number of adults (and young) observed by section										
	July	41-42	42-43	43-44	44-45	46-47	47-48	48-49	49-50	50-51	51-52	52-53	54-55
Red-necked Grebe	18												
	26			7									
Unidentified grebe	18										1		
	26	1		2									
American White	18												
Pelican	26												
Canada Goose	18												
	26												
American Wigeon	18		4		1(4)		1(4)						
	26						1(6)		1	2			
Mallard	18			1						13			
	26	1	2	3									
Blue-winged Teal	18												
	26												
Northern Shoveler	18									1			
	26												
Northern Pintail	18												
	26	1											
Green-winged Teal	18												
	26			1					1	6			
Unidentified teal	18						1(1)						
	26		1										
Unidentified	18	7(5)	4			1(5)			2(11)		1(5)		
dabbler	26		2	1			3		1	5(11)	3		
Canvasback	18												
	26												
Unidentified scaup	18			7(3)									
	26									2(8)			
Surf Scoter	18												
	26												
Bufflehead	18									1(7)			
	26						1						
Common	18												
Goldeneye	26												
Red-breasted	18												
Merganser	26												
Unidentified	18												
merganser	26												
Ruddy Duck	18												
	26			1									
Unidentified diver	18			1		1			5	7	5		
	26						1			26		2	

Appendix 3. Continued.

Species	Date:	Number of adults (and young) observed by section							
	July	55-56	56-57	57-58	58-59	59-60	total	Ring Lake	Hook Lake
Red-necked Grebe	18						0		
	26				2		10		4
Unidentified grebe	18						5		
	26						3		
American White	18						2		
Pelican	26						0		
Canada Goose	18						2		
	26						0		
American Wigeon	18				4		59(11)		
	26						25(6)		
Mallard	18			2			54(9)		
	26						18(8)	1	
Blue-winged Teal	18						0		
	26						1		
Northern Shoveler	18				1(7)		3(7)		
	26						0		
Northern Pintail	18						9(2)		
	26						2(12)		
Green-winged Teal	18						1		
	26						19		
Unidentified teal	18						1(1)		
	26						1		
Unidentified	18	2					39(31)		
dabbler	26		2(10)				59(35)		4
Canvasback	18						1		
	26						1		
Unidentified scaup	18				3		47(8)		
	26				15		32(13)		
Surf Scoter	18						0		
	26						0	2	
Bufflehead	18						4(7)		
	26						2		
Common	18						0		
Goldeneye	26						4		
Red-breasted	18						0		
Merganser	26						3		
Unidentified	18						0		
merganser	26						0	3	
Ruddy Duck	18						3		
	26				2		3		
Unidentified diver	18						31(12)		
	26				4		43(8)	10(5)	

Appendix 3. Continued.

Species	Date:	Number of adults (and young) observed by section											
	July	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-13
Unidentified duck	18	2					1					6	
	26							6					
Bald Eagle	18		9		1(1)								
	26	1(1)	(1)		1								
Unidentified eagle	18		2										
	26												
Northern Harrier	18								1				
	26												
Red-tailed Hawk	18												
	26												
Unidentified buteo	18												
	26												
American Kestrel	18												
	26												
American Coot	18												
	26												
Sandhill Crane	18												1
	26												
Unidentified	18	2	1		1			2	2				2
shorebirds	26	1		1	1			1					
Bonaparte's Gull	18												
	26												
White-headed gull	18	3	37	2	6								
	26		2		1								
Black Tern	18												
	26												
Unidentified tern	18												5
	26										2		1
Great-Horned Owl	18												
	26		.										
Northern Hawk	18												
Owl	26												
Short-Eared Owl	18										1		
	26												
Belted Kingfisher	18												
	26												
Common Raven	18		1		6								
	26												
Total species	**18**	**3**	**6**	**1**	**4**	**0**	**1**	**4**	**2**	**1**	**2**	**2**	**7**
	26	**3**	**2**	**1**	**3**	**0**	**0**	**3**	**0**	**1**	**1**	**2**	**6**

Appendix 3. Continued.

Species	Date:	Number of adults (and young) observed by section											
	July	13-14	14-15	15-16	16-17	17-18	19-20	20-21	21-22	23-24	24-25	25-26	26-27
Unidentified duck	18	6	1					6	1				
	26		12	2(6)		2(6)			12	2(6)		2(6)	
Bald Eagle	18					2(2)						2(2)	
	26					2(2)						2(2)	
Unidentified eagle	18												
	26												
Northern Harrier	18												
	26			1		1	1			1		1	1
Red-tailed Hawk	18												
	26												
Unidentified buteo	18												
	26				1						1		
American Kestrel	18												
	26												
American Coot	18												
	26												
Sandhill Crane	18												
	26												
Unidentified	18		2						2				
shorebirds	26	1				3		1				3	
Bonaparte's Gull	18												
	26			1						1			
White-headed gull	18												
	26												
Black Tern	18												
	26												
Unidentified tern	18			4						4			
	26	2	1				1	2	1				1
Great-Horned Owl	18												
	26						1						1
Northern Hawk	18												
Owl	26												
Short-Eared Owl	18												
	26					2						2	
Belted Kingfisher	18												
	26												
Common Raven	18					1						1	
	26												
Total species	**18**	**2**	**4**	**5**	**1**	**2**	**0**	**2**	**4**	**5**	**1**	**2**	**0**
	26	**2**	**4**	**7**	**0**	**6**	**4**	**2**	**4**	**7**	**0**	**6**	**4**

Appendix 3. Continued.

Species	Date:	Number of adults (and young) observed by section											
	July	27-28	28-29	30-31	31-32	32-33	33-34	34-35	35-36	37-38	38-39	39-40	40-41
Unidentified duck	18	8	1			1	1		1				
	26	9	4	10(8)	1	9(5)	2	1					1
Bald Eagle	18												
	26												
Unidentified eagle	18												
	26												
Northern Harrier	18												
	26												
Red-tailed Hawk	18												
	26												
Unidentified buteo	18												
	26												
American Kestrel	18							1					
	26				1								
American Coot	18												
	26												
Sandhill Crane	18												
	26												
Unidentified	18												
shorebirds	26	1											
Bonaparte's Gull	18												
	26												
White-headed gull	18			1									
	26												
Black Tern	18												
	26												
Unidentified tern	18												
	26												
Great-Horned Owl	18												
	26							1					
Northern Hawk	18												
Owl	26												
Short-Eared Owl	18												
	26			1									
Belted Kingfisher	18												
	26												
Common Raven	18												
	26												
Total species	**18**	**5**	**2**	**2**	**4**	**2**	**2**	**2**	**1**	**1**	**3**	**0**	**0**
	26	**8**	**1**	**4**	**4**	**4**	**1**	**3**	**1**	**1**	**0**	**0**	**2**

Appendix 3. Continued.

Species	Date:	Number of adults (and young) observed by section											
	July	41-42	42-43	43-44	44-45	46-47	47-48	48-49	49-50	50-51	51-52	52-53	54-55
Unidentified duck	18	2(5)		(17)					3(2)	2	4(3)		
	26		4	25			3		2(3)	22(7)	10		
Bald Eagle	18							1					
	26												
Unidentified eagle	18												
	26												
Northern Harrier	18												
	26												
Red-tailed Hawk	18												
	26												
Unidentified buteo	18												
	26												
American Kestrel	18												1
	26												
American Coot	18										1		
	26	4(5)					1						
Sandhill Crane	18												
	26												
Unidentified	18								1				
shorebirds	26												
Bonaparte's Gull	18												
	26												
White-headed gull	18												
	26							1				1	
Black Tern	18												
	26												
Unidentified tern	18	2											
	26			1									
Great-Horned Owl	18												
	26												
Northern Hawk	18												
Owl	26												
Short-Eared Owl	18												
	26												
Belted Kingfisher	18												
	26												
Common Raven	18												
	26												7
Total species	**18**	**3**	**2**	**4**	**1**	**1**	**2**	**1**	**4**	**5**	**5**	**0**	**1**
	26	**4**	**4**	**8**	**0**	**0**	**6**	**1**	**4**	**6**	**2**	**2**	**1**

Appendix 3. Continued.

Species	Date:	Number of adults (and young) observed by section							
	July	55-56	56-57	57-58	58-59	59-60	total	Ring Lake	Hook Lake
Unidentified duck	18		1	4	4(3)		73(30)		
	26		6(6)	9	11		167(50)	(8)	(7)
Bald Eagle	18						13(3)		
	26						4(4)		
Unidentified eagle	18						2		
	26						0		
Northern Harrier	18						3		
	26	1					6		
Red-tailed Hawk	18						0		
	26		1				1		
Unidentified buteo	18						0		
	26						1		
American Kestrel	18						2		
	26						1		
American Coot	18				1		3		
	26				4(9)		14(14)		
Sandhill Crane	18						1		
	26					1	1		
Unidentified	18						15		
shorebirds	26						10		1
Bonaparte's Gull	18						0		
	26						1		
White-headed gull	18					1	52		
	26						8		
Black Tern	18						0		
	26						1		
Unidentified tern	18						13		
	26						10	2	
Great-Horned Owl	18						0		
	26						2		
Northern Hawk	18						0		
Owl	26						1		
Short-Eared Owl	18						1		
	26						3		
Belted Kingfisher	18						0		
	26						0	1	
Common Raven	18						8		
	26						7		
Total species	**18**	**1**	**1**	**3**	**6**	**1**	**28**	**0**	**0**
	26	**1**	**3**	**1**	**6**	**1**	**32**	**7**	**4**